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The number of eggs and cocoons produced by *Tetragnatha praedonia* (Araneae: Tetragnathidae) under rearing conditions

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Abstract — A total of eleven females of *Tetragnatha praedonia* (Tetragnathidae) reared in the laboratory produced between one and seven cocoons during their life span. Brood size (the number of eggs per cocoon) varied from 47 to 234. The total number of eggs produced by a female spider varied greatly, from 82 to 1240 eggs, and was strongly correlated with the number of cocoons produced. These results suggest that *Tetragnatha praedonia* can make several cocoons during its life span if conditions, such as prey abundance, are favorable. Although the brood size was significantly correlated with the carapace length, the total number of eggs produced primarily depended on the number of ovipositions. Thus, well-fed individuals may construct more cocoons and consequently produce more eggs over a lifetime. The generational overlap in *T. praedonia* may be explained in part by the successive ovipositions of each female spider. Both the short life span and the successive ovipositions of *T. praedonia* appear to be advantageous in unstable and disturbed habitats.

Key words — generational overlap, successive ovipositons, brood size, total number of eggs, habitat use

Introduction

A tetragnathid spider, *Tetragnatha praedonia* exhibits two or three overlapping generations per year in western Japan (Okuma 1977; Yoshida 2002). The generation overlap may be caused by the large variation in the nymphal development time from hatchling to adult or by successive ovipositions of each female spider (Yoshida 2002).

So, I investigated the number of eggs and cocoons produced by *T. praedonia* under rearing conditions in order to verify whether a female spider lays more than one egg sac successively or not. I will present the results and discuss the life history characteristics and the habitat use of *T. praedonia*.

Methods

Juveniles of *Tetragnatha praedonia* were collected on the campus of Ritsumeikan University, Kusatsu, Shiga Prefecture, Japan, in June and July 2005. The spiders were reared individually in glass tubes (3 cm in diameter and 11 cm in length) at room temperature (25–30°C) and were offered various insects (midges, caddisflies, mayflies, and moths) almost daily. After completing its final molt, each female spider was mated with a male spider in another glass tube and then returned to a glass tube. The cocoons produced by females were weighed, and the numbers of eggs laid were counted. Egg size (live weight) was calculated by dividing live weight of a cocoon by the number of eggs in each cocoon. The spider carapace length was measured post-mortem, with a binocular microscope in the laboratory.

Results

A total of eleven juvenile spiders became adult females following one or two molts. The carapace length of adult females was 2.5–3.7 mm (mean±standard deviation, 3.2± 0.4 mm). All the female spiders made cocoons with dark secretions (Fig. 1) inside the glass tubes or on the cork stoppers. The first cocoon was constructed 5–10 d after the final molt. The interval between ovipositions was 2–5 d (Fig. 2). Spiders produced between one and seven cocoons, although the individual variation was large (mean 3.1±2.2 cocoons, median 2, N=11; Fig. 2). All females died 6–38 d after the final molt.

Brood size (number of eggs in a cocoon) varied from 47 to 234 (mean 151±46, median 156, N=34), and egg size ranged from 0.12 to 0.22 mg (mean, 0.17±0.03 mg, N=34). The total number of eggs produced by a spider before death varied greatly from 82 to 1240 (mean 467±399, median 292, N=11). The total egg number was strongly correlated with the number of cocoons ($r=0.98$).

Figure 3 illustrates the relationship between the carapace length and brood size (Fig. 3A) and between the carapace length and total egg number (Fig. 3B). Brood size was significantly correlated with carapace length ($r=0.50$, $P<0.01$), but this correlation was weak, probably because larger females oviposited both large and small broods. For example, the largest female (carapace length, 3.7 mm) made seven cocoons, with 110–234 eggs per cocoon. Similarly, total egg number was significantly correlated with carapace length, and the correlation was again somewhat weak (*r*

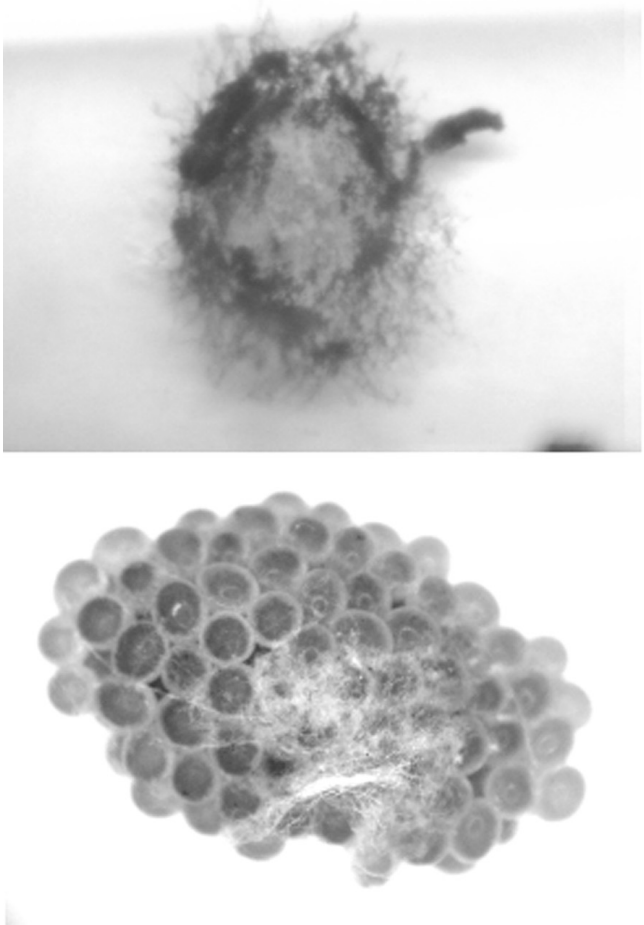

Fig. 1. The cocoon (above) and egg-mass (below) of *Tetragnatha praedonia*. The cocoon is dark with secretion of the spider.

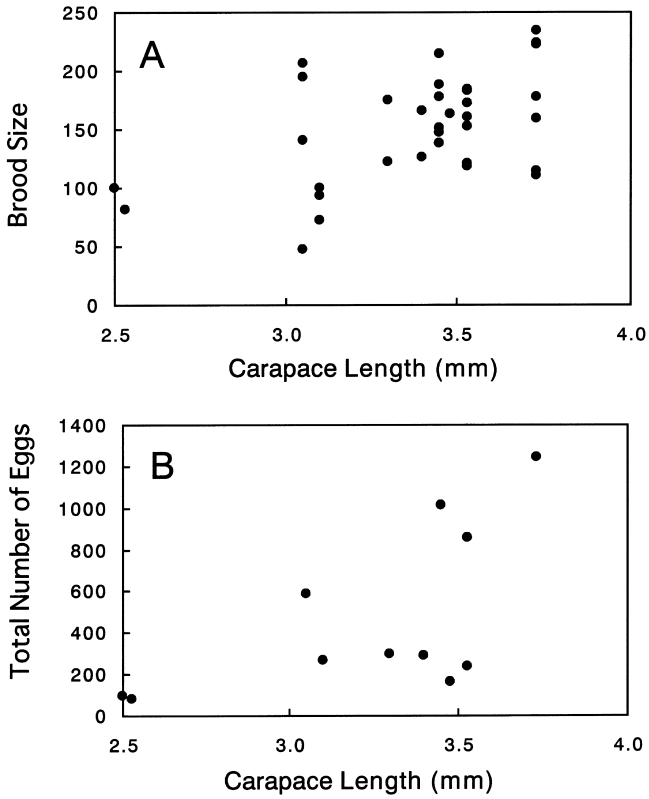

Fig. 3. The relationships between the carapace length and brood size (A) and between the carapace length and total egg number (B) in *T. praedonia*.

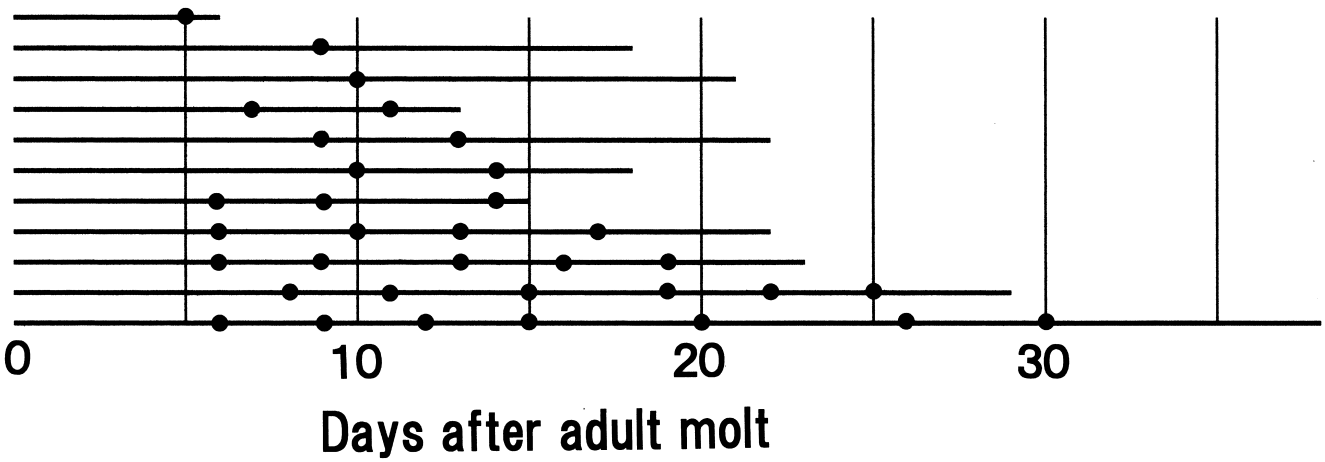

Fig. 2. The records of egg sac production by *T. praedonia*. Solid lines represent the periods of eleven females from adult molt to the spider's death. Solid circles represent oviposition.

$=0.60$, $P<0.05$), perhaps because large females did not always make a large number of cocoons. Indeed, the number of cocoons was not significantly correlated with spider carapace length ($r=0.56$, $P>0.05$), nor was egg size correlated with carapace length ($r=0.08$, $P>0.1$).

Discussion

The rearing of *T. praedonia* demonstrated the flexibility of this species' oviposition system. Most individuals made two or more cocoons, although some individuals made only one (Fig. 2). These results suggest that *T. praedonia* can make several cocoons during its life span if conditions, such as prey abundance, are favorable. Although the brood size significantly correlated with the carapace length (Fig. 3), the total number of eggs produced primarily depended on the number of ovipositions. Thus, well-fed individuals may construct more cocoons and consequently produce more eggs over a lifetime.

When spiders are given more prey, they mature more rapidly and become larger adults (Miyashita 1968; Sato 1985; Vollrath 1987). However, larger females do not always produce more eggs over a lifetime (Fig. 3), because some larger individuals make few cocoons in *T. praedonia*. It was not clear why larger individuals did not always make an abundance of cocoons.

Tetragnatha praedonia has two or three overlapping generations per year in western Japan (Okuma 1977; Yoshida 2002). This generational overlap may be explained in part by the successive ovipositions of each female spider. Generations may also overlap because of the large variation in nymphal development time from emergence to adult. This latter possibility warrants further investigation.

Tetragnatha praedonia inhabits natural habitats, such as mountain streams (Yoshida 1981, 2001), as well as unstable and disturbed habitats, such as isolated shoals in rivers (Yoshida 1995), paddy fields (Hamamura 1969; Okuma 1977), and brooks with concrete banks and bottoms (Yoshida 2001, 2004). Shoals are flooded or destroyed by heavy rains at irregular intervals. Weeds are removed in paddy fields, and shrubs and grasses on the banks of brooks are cut at intervals. In such unstable and disturbed habitats, both the short life span (Yoshida 2002) and the successive ovipositions (current study) of *T. praedonia* appear to be advantageous. For example, *T. praedonia* may be able to complete its life span prior to the abrupt change of habitats, or it may leave many offspring if favorable conditions persist.

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